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Publication date:
2017

Document Version
Peer reviewed version

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Citation (APA):

Villa, M., Hansen, M. F., & Somers, M. A. J. (2017). *Determination of the activation energy of Martensite formation in steel during heating from 77 K*. Abstract from International Conference on Martensitic Transformations 2017, Chicago, Illinois, United States.

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Determination of the activation energy of martensite formation in steel during heating from 77K

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ABSTRACT

Fe-based alloys and steels were austenitized and quenched to room temperature and additionally to boiling nitrogen temperature to investigate the kinetics of martensite formation on (re)heating with magnetometry. In precipitation hardenable stainless steels of types 17%Cr-7%Ni and 15%Cr-7%Ni-2%Mo, wherein lath martensite develops, transformation was fully suppressed during immersion in boiling nitrogen. The kinetics of lath martensite formation was followed for the following conditions: (i) isochronal (re)heating at different heating rates; (ii) isothermal holding at different temperatures. The activation energy of martensite formation as quantified by a Kissinger-like method equals 8–12 kJ/mol, independent of the type of test performed. In Fe-C, Fe-N, Fe-Cr-C and Fe-Cr-Ni alloys forming (lath and) plate martensite, transformation cannot be prevented during immersion in boiling nitrogen. Isochronal heating tests showed that the activation energy of the martensite that forms during heating depends on the fraction of interstitials in austenite and ranges in the interval 8–25 kJ/mol.

KEYWORDS

Isothermal martensite; cryogenic treatments; steel;